MINERAL EXPLORATION

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Economic Development Branch
BC Ministry of Sustainable Resource Management

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Coast Region (MSRM)

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BUILDING BLOCKS FOR ECONOMIC DEVELOPMENT & ANALYSIS

PREFACE

PURPOSE

Building Blocks have been conceived and developed by the Economic Development Branch of the Ministry of Sustainable Resource Management, under the guidance of Nancy South, Manager Economic Analysis, as an analytical tool that supports British Columbia coastal and land and resource use planning and decision-making and economic development initiatives. The Blocks contain concise business and sector information for a broad range of resource-based business types in BC. At this point, there are more than 30 Blocks either complete or in draft form. Several more Blocks have been identified as high priority by planning tables and other client groups. Additional Building Blocks will be developed over time, and some Blocks may be updated. For the most current Building Blocks, please see the Ministry of Sustainable Resource Management website, at: http://srmwww.gov.bc.ca/rmd/ecdev/

ACKNOWLEDGEMENTS

Generous support in terms of both funding and staff time has been provided by the Ministries of Energy and Mines; Water, Land and Air Protection; Agriculture, Food and Fish; and Forests, as well as by Skeena and Coast Regions of the Ministry of Sustainable Resource Management.

BENEFITS

Building Blocks are expected to provide the following general benefits:

- Increase efficiency and more informed decision-making by providing readily accessible, credible information to planning and economic development processes;
- Improve the consistency of economic information across planning areas;
- Support economic analysis and decision-making that occurs outside formal coastal and land use planning processes; and
- Provide linkages between economic analysis and other social and environmental analytical tools (through identifying resource requirements to support economic activities and general compatibilities with other sectors and values).

LIMITATIONS

Every effort has been made to ensure that the information contained in Building Blocks is accurate and consistent. Approved, credible data sources are the foundation for Building Blocks. All Blocks were reviewed by sponsoring agencies and other experts. However, users are cautioned that information is used at their own risk, and that the authors and sponsors are not liable for any damages. Any conclusions or interpretations by the authors are not intended to represent government policy. Also, note that Building Blocks do not provide site specific information nor do they consider requirements for sustainability (social, community, environmental).

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RECOMMENDED REFERENCE/CITATION

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1.0 THE MINERAL EXPLORATION BUSINESS

1.1 Ownership of Mineral Resources in Canada

In Canada, the vast majority of subsurface mineral resources are owned by the Provinces in right of the Crown. Those resources that are not unequivocally held by the Province include fee simple lands, Federally-held land and treaty settlement lands. The Provinces lease publicly-owned mineral rights to private companies or individuals who wish to secure tenure for the purposes of exploration for possible minerals. Mineral tenure arrangements vary between provinces, but in general mineral claims convey the rights to explore for minerals on those claims subject to a number of conditions including minimum work commitments (or fees in lieu), adherence to environmental standards, reporting etc. Where an economic discovery is made and a property is advancing towards production status, mineral claims in the immediate area are generally converted into a form of production lease, wherein the lessor has the rights to develop and attain production, subject again to adherence to all applicable laws and regulations, and payment of mineral royalties to the Crown.

1.2 The Nature of Mineral Deposits

Minerals exploration is characterized by a number of factors that distinguish it from other resource sectors such forestry, hydropower, and recreation.

- Minerals are public resources that are largely hidden from the view those wishing to locate them.
- Mineral deposits are "where you find them" – they cannot be moved to a location that is more convenient for resource planners.
- Once a deposit is found, it can develop over time into a "mining camp". Many deposit types are found in clusters. The development of the first deposit in an area, with its associated infrastructure, leverages the development of additional discoveries, by reducing costs. Examples of this include the high grade gold deposits of Bralorne and the large Highland Valley copper deposits where, over decades, multiple mines/deposits eventually were developed from single mine operations.
- Defining an economic mineral deposit is time-consuming, costly, and high risk, requiring the use of advanced technologies such as remote sensing and geophysical methods employed over large areas. The likelihood of an individual mineral occurrence eventually being developed as a mine is low, less than 0.1%, or 1 per 1000.

Low numbers of identified mineral deposits in a tract do not necessarily imply low mineral potential, even if some past exploration has occurred in the area. It may simply be the result of lack of modern exploration, incorrect geologic theories, poor infrastructure, or government policy. For example, prior to the diamond discoveries in the Northwest Territories, there were no known occurrences of kimberlite pipes (the host for diamond deposits) there. The

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geology was known to be favourable, but previously no one had the interest, persistence and money to explore for diamonds. Discoveries of previously unknown mineral occurrences in new areas can rejuvenate exploration interest and lead to significant resource values.

1.3 Geological Concepts

Designing an exploration approach for a particular metal or mineral requires some knowledge or an hypothesis of how and why a mineral occurs in nature in a particular place in the earth's crust. **Minerals** are naturally-occurring combinations of **elements**. Examples are iron and sulphur forming FeS_2 (pyrite), or with copper, $CuFeS_2$ (chalcopyrite). **Metals** such as gold, silver and copper, are particular types of elements with a metallic lustre and certain other physical properties that's distinguish them from non-metallic elements. Metals can occur in nature in element form or as part of a mineral. In this report, the words "metals" and "minerals" are used interchangeably and (except for oil and gas) refer to naturally occurring substances of economic interest.

Minerals have physical properties or modes of occurrence that can be used to assist in locating deposits of economic interest. Some common mineral characteristics that can be used are:

1. Magnetic susceptibility: These can produce magnetic anomalies that can be used to isolate prospective areas using magnetometers.
2. Specific gravity: Deposits with high (or low) specific gravity can produce local anomalies in the gravitational field that are detectable by gravimeters.
3. Conductivity: High or low conductivity produces anomalies in the electromagnetic field around the deposit. This field can be induced by artificial means from aircraft- or ground-based transmitters.

4. Radioactivity: This can be detected with instruments;
5. Velocity of seismic waves: For layered deposits, reflections of artificially generated seismic (sound) waves arising from rock layers of differing densities can be measured and, after processing, used to interpret the subsurface geological features;

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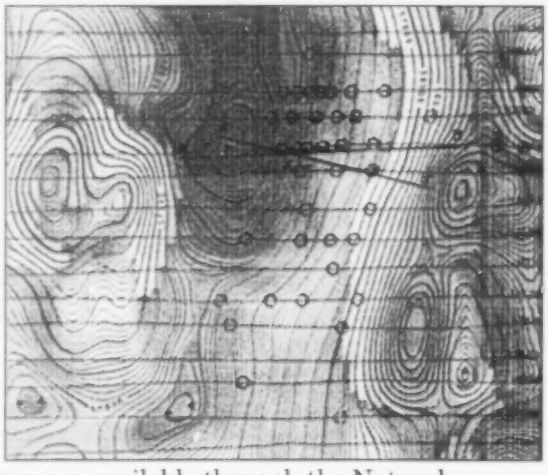
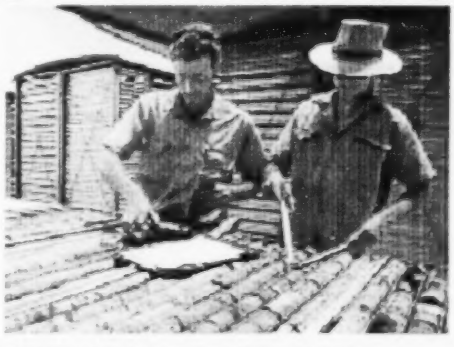
6. Association with other rocks or minerals: The mineral of economic interest may occur in association with other rocks or minerals that may be easier to locate than the economic minerals themselves.
7. Chemical signatures of hidden mineral deposits are often dispersed over wide areas by chemical or physical processes such as weathering and erosion, thus making their presence known by sampling stream silts on a regional basis, soils or glacial till.

1.4 Designing an Exploration Approach

The exploration approaches taken to locate new mineral deposits will vary depending on a number of factors such as the type of deposit (e.g. vein type, disseminated, layered), the location of the area, availability of infrastructure, the existence and quality of other available exploration information in the area.



For example, an exploration approach that is appropriate for locating a large, disseminated copper deposit would be generally unsuitable in locating small high-grade gold deposits. A search for deposits in a previously un-explored area starts with gathering basic geological data and research information on known showings or exploration results. Much of this basic scientific information is available from the Provincial government[1]. The Province has also developed mineral potential maps that can assist geologists in determining favourable areas for specific deposit types[2]. Topographic maps, air photos and satellite imagery are available through the Natural Resources Canada[3]. The type of deposit under consideration will determine the favourable geology and focus the explorationist on those areas. Regional-scale exploration reconnaissance programs are then used to further localize an area of interest. This type of regional program can include helicopter–supported or ground stream silt and soil sampling, airborne magnetometer, gravity or electromagnetic (EM) surveys with ground follow-up. Areas worthy of further work based the regional program are normally staked and more detailed exploration programs including soil sampling, rock sampling, detailed mapping, drilling and trenching, are devised for these areas.



Exploration in an area often follows cycles, whereby an initial exploration concept is developed and some field work occurs with, say, negative results. This previously-explored area then attracts renewed interest decades later, perhaps due to a new concept of mineral deposit formation (e.g. diamond discoveries in Northern Canada) or new

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exploration technology (e.g. use of satellite imagery) that re-focuses attention on that area. Unsuccessful exploration in an area does not necessarily mean that significant mineral deposits do not exist there. It could well be the case that the type of exploration was incorrect, the level of effort was insufficient (this is especially the case in rugged remote areas of the Province), or old technology was incapable of locating these deposits. Some examples of new deposits found in previously-explored areas of B.C. include the high grade Eskay Creek deposit in north western B.C. and a new gold deposit recently discovered in the historic Barkerville gold camp.

1.5 Mineral Tenures

Companies and prospectors undertaking high-risk mineral exploration require secure tenure for their mineral properties in the event that a promising discovery is made. Legal title to minerals in British Columbia can be held under four types of tenure:

1. Freehold lands
2. Staked (located) mineral claims
3. Crown granted mineral claims
4. Mining or placer lease

Staked and Crown granted mineral claims total approximately 3 million hectares in B.C. roughly 3% of the area of the Province land and water area. The area covered by mining leases (excluding coal) is tiny in comparison, covering only 47,000 hectares, less that 0.05% of the land area. Together all claims, and mining, placer and coal leases comprise some 3.5 million hectares, 3.5% of the provincial land area

Freehold Title

Freehold title is administered by the Land Title Branch, Ministry of Attorney General. This is usually included as part of another form of title such as private surface, federal railway settlement grants, etc.. The right to the minerals would be stated on the Certificate of Title and could be either inclusive of all minerals or be restricted to specific minerals. Freehold title is not subject to any provision of the *Mineral Tenure Act*[4]

Crown Granted Mineral Claim

Crown Granted Mineral Claims are a special form of mineral claim. The Crown grant document may specify certain minerals, such as all base metals, all precious minerals, gold and silver, etc.. In the absence of specifics it would include those minerals as defined in the *Mineral Act* in force when the grant was issued. Crown granted titles are not subject to the provisions of the *Mineral Tenure Act*, except that they can be included in mineral groupings for the purpose of recording work done on the Crown grant and applying it to mineral claims in the group. Issuance of Crown granted mineral rights generally ended in 1957. There is an annual mineral tax assessed in order to maintain title.

Located Mineral Claim

Located mineral claims in British Columbia are secured through "**staking**". In the past, staking involved physically establishing "**claim posts**" in the desired areas (areas that has not already been staked by others). These posts describe a rectangle of land generally 500

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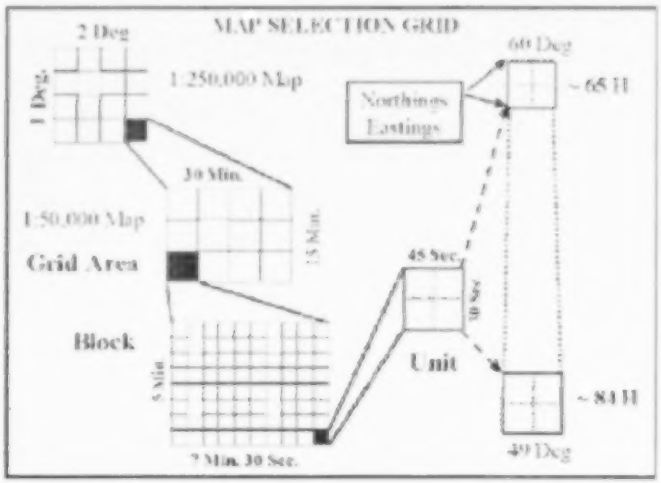
meters square (25 hectares). Groups of contiguous claims can be also established, not to exceed 500 hectares. Any mineral production on a mineral claim is limited to a maximum of 1,000 tonnes of ore per unit per year or a 10,000 tonne bulk sample as permitted in the regulations. Production on a placer claim is limited to 2,000 cubic metres of pay dirt per year.

Mineral claims can be located only in areas open for staking. For example, parks, Indian reserves and other areas reserved by government cannot be staked. Staking can only be made by an individual or Company holding a **Free Miners Certificate**. Individuals must be over the age of 18 and Canadian citizens (or individuals authorized to work in Canada).

B.C. is now moving to a "**Map Staking**" system whereby claims can be located using an internet-based geographic map-based system. This system would allow explorationists to see, from their office computer, areas that are already staked, and reserved areas that are unavailable for staking. Map staking is in use in other jurisdictions (e.g. Quebec) with some success.



Rights Acquired by a Mineral Title

A mineral or placer claim acquires the right to the minerals or placer minerals which were available at the time of location and as defined in the *Mineral Tenure Act*. There are no surface rights included, but the title holder has the right to use the surface of the claim for mining purposes only. This does not include the right to live on the claim, or build a cabin, house or any other building or dwelling.

Mining Leases

Mineral production that exceeds the levels mentioned above require a **lease**. A lease is a long-term entitlement to minerals that is designed as a production tenure. There are no work requirements on a lease. An annual rental is paid to maintain the title.

Work Standards

All work carried out on a mineral claims, as with all mineral and placer titles, is subject to the provisions of the *Mines Act* and related statutes. A Mineral Exploration Code and Best Practices guidebook is currently in preparation by the B.C. Ministry of Mines and Energy (MEM). Major portions of this information are already available on the MEM website[5 and 6]. All exploration operators must make notification of any proposed work before commencement.

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Access to Private Land

Holders of mineral rights have the right, subject to certain restrictions, to access the surface of privately owned land for purpose of exploring their mineral holdings. Claim holders have the right of entry to private land, including equipment, given notification to the *Gold Commissioner*, the landowner. Compensation must be made for any disturbance. The claim holder cannot obstruct any activities on this private property. The land owner also has the right to seek mediation and arbitration if disputes cannot be settled between the parties with the assistance of the *Gold Commissioner*.

"Two-Zone" Concept for Mineral Development

In order to provide certainty for mineral explorers and rights holders, the B.C. Government has legislated a "two-zone" system for mineral exploration and mining. The two-zone system ensures mining applications are considered, subject to all applicable laws, anywhere but in a park, ecological reserve, protected heritage property or an area where mining has been prohibited by an order under the *Environment and Land Use Act*.

The two-zone system does not change the permitting system or environmental standards for mineral activities. The *Mines Act, Mineral Tenure Act* and related performance-based codes of practice, regulations and guidelines remain the primary permitting, compliance and enforcement instruments for mineral activities. Authorizations required from other agencies, for example *Forest Practices Code of British Columbia Act* special use permits or *Forest Act* cutting permits, will be facilitated through the single window administered by MEM. Mining activities in the mineral zone lands remain subject to the *Mines Act*, and, where applicable, the *Environmental Assessment Act* as well as all required environmental regulations and approvals. Broad public consultation occurs as applicable under these acts.

1.6 First Nations and Community Consultation

For perhaps somewhat different reasons, both the First Nations and the general public should have a common interest in the economic development of the Province. First Nations people, by virtue of their occupation of the land for thousands of years, often have first hand local knowledge of minerals deposits.

Consultations with stakeholder groups regarding future mineral exploration and development activities should be an important part of any exploration program that could have significant impacts on these groups. First Nations, as a result of various Court decisions, have certain rights in areas of established historical occupation and use. In 1982, aboriginal rights were recognized and affirmed in Section 35(1) of the *Constitution Act, 1982*. Recent court decisions, including the 1990 *Sparrow*, 1996 *Van der Peet* and the 1997 *Delgamuukw* decision have opined on the nature of aboriginal rights and, as a consequence redefined the legal relationship between the Government of British Columbia and aboriginal

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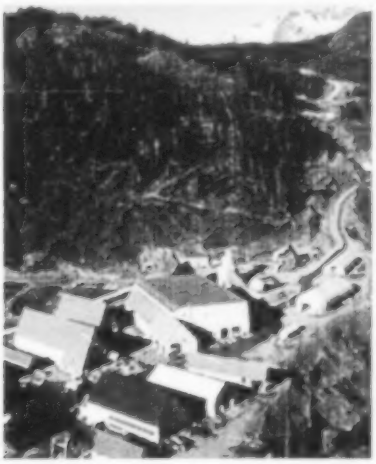
peoples. Land claims settlements are the joint responsibility of the Federal and British Columbia Governments.

The public-at-large also has a general interest in new job creation, new sources of tax revenue and preservation of the environment. Exploration activities that may impact on these public concerns should be addressed by public consultations at the appropriate time. The environment impacts of early stage exploration activities are relatively minimal compared with other industrial activities, particularly at the early stages of exploration. For regional reconnaissance exploration, utilizing helicopter support, the impacts are not only low, but of short duration.

As exploration progresses for those properties of merit, the increased visibility of this activity, which may involve establishing camps and drilling, would suggest that some initial information sessions be held with local and First Nations groups. Even more advanced exploration may involve road construction, test mining, bulk sampling, feasibility and engineering studies, and environmental baseline work. At this stage, more extensive consultations and public forums should be established to inform other crown land tenure interests and local stakeholder groups, address any concerns and elicit feedback.

Development of an eventual mining operation, such the Eskay Creek operation in north western B.C. (depicted on the right), has a much greater impact and requires extensive consultations and numerous studies and permits



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2.0 THE EXPLORATION INDUSTRY

2.1 The Science of Exploration

Since many, if not most, mineral deposits are subsurface or otherwise hidden from direct view, many techniques and instruments have been devised over the years to detect the subtle indications that a mineral deposit may lie hidden. As previously mentioned, mineral deposits have unique characteristics that can be used to help locate them. Explorationists have devised techniques and instruments that make use of characteristics to help locate deposits.

Exploration technologies in common use include satellite imagery, satellite radar imagery, airphoto interpretation, geographic positioning systems (GPS), airborne and ground magnetometers and gravimeters, airborne and ground EM systems, 3D imaging and exploration data and deposit visualization software, geological mapping, geostatistical software, seismic surveys, silt, soil and rock sampling geochemical analysis, core and reverse circulation drilling.

Each of these technologies can be used separately or together depending on the type of mineral, the type of mineral deposit and the stage of exploration evaluation. Mineral deposits occur in many different forms that require differing exploration approaches. Small narrow vein-style deposits require a different exploration approach than large disseminated copper deposits that may occupy many hectares.

2.2 The Economics of Mineral Exploration

Mineral deposits are public resources that, unlike forests, do not grow over time, they cannot move about like bears or animals, and they cannot be located or measured by satellite, airphotos or by tape measure. Location and measurement of mineral deposits require luck, geological insights, and exploration techniques that zero in from broad-scale methods such as regional geochemistry and airborne geophysics to more localized methods such as ground geophysics, rock sampling, and eventually drilling. Because individual economic mineral deposits are rare, exploration requires large tracts of land be available for exploration over long time periods to maximize the chances for locating significant occurrences. Although minerals exploration may encompass large tracts of land, the impacts of exploration are relatively limited in terms of the length of time of such impacts, and the severity of impacts. The relatively few mining operations that eventually emerge occupy relatively small areas, by some measures disturbing

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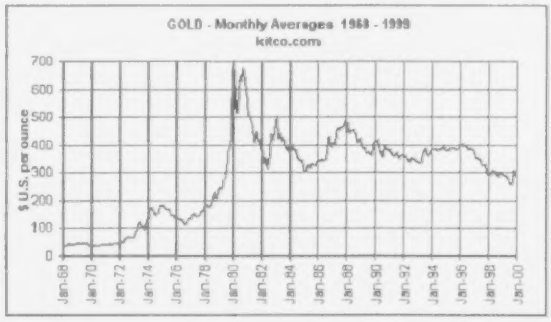
only 0.1% of the B.C. land mass on a cumulative basis and only for relatively short periods of time if properly operated and reclaimed.

Mineral deposits that are delineated (partially or fully) and found to be uneconomic at current prices, may become economic in future as a result of higher metal prices or new mining or extraction technologies. Even though they may be uneconomic under current conditions, these "*inventory*" mineral deposits have considerable public resource values not only for their future development potential, but also for the "*information value*" associated with the knowledge of how they occur. This information value improves the likelihood of location of additional mineral deposits.

Mineral deposits, if developed into mining operations, typically produce high values for employment and economic rent in relation to the land area disturbed by such activities. According to industry reports, B.C. mining activities generate annual direct revenues of about $150,000 per hectare, compared with approximately $5,700 for forestry and $1,400 for agriculture.

Under-explored Crown lands and mineral deposits that are non-economic under current economic conditions still have significant potential values as forms of development "call options". New extraction technologies, new uses for metals and market shifts can improve the development prospects for marginal mineral deposits and provide the impetus for renewed exploration and possible development.

Commodity Prices and Demand



Many metals and minerals are produced and sold on a worldwide basis. Long term metals prices are established by the balance of supply and demand for each commodity. For many major metals such as copper, lead, zinc, aluminum, gold etc., trading mechanisms, such as COMEX and the London Metals Exchange, have been established to facilitate trading and allow for price hedging. Worldwide demand for metals grows steadily at long term rate of 1-3% annually. Even this apparently slow rate of growth means that significant additions to metal supply must be made on a sustained basis. This new supply comes from new mine developments, expansion to existing operations and/or increased recycling.

Example

Suppose an exploration company has evaluated 100 mineral prospects over a 10 year time period and has spent $50,000,000 on exploration and feasibility studies. After this 10 year program, the company has identified 10 deposits with measurable resources but only one project with economic development potential. In order for this company to survive and prosper in the long term, this single project must generate sufficient profit to not only repay its own capital investment, but also generate enough surplus profit to recover the $50 million in prior exploration costs and the accumulated opportunity cost of capital on these

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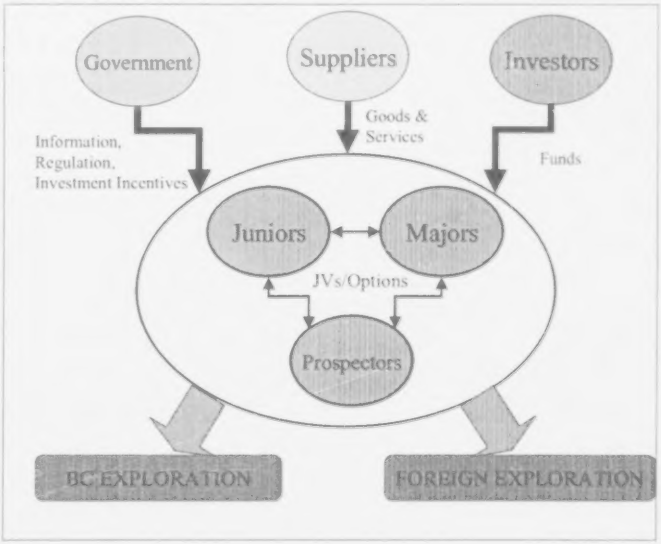
expenditures. This single successful project must cover all the associated costs of exploration for all the exploration effort required to find it. If this single project has a capital cost of, say, $100 million, the project must generate **$500 million** in future profits to yield a 15% overall rate of return (pre-tax) on the total $150 million investment including prior exploration.

The long time frames associated with mineral exploration, discovery and project development means that, for survival over the long term, companies must have either large financial resources, available over long periods of time, or distribute the risks of discovery and development by forming alliances or joint ventures with other companies.

2.3 Exploration Industry Structure

The exploration business consists of four major participants, each having a role to play in sustaining the viability of the industry:

1. Government
2. Individual Prospectors
3. Junior exploration companies
4. Senior mining companies
5. Service providers



It should be noted that the exploration business is worldwide in scope. Exploration companies may be Vancouver-based but their activities take place where there are opportunities. Over 2,000 individuals and several hundred mining and service companies are directly or indirectly engaged in exploration or exploration-related activity in B.C. (table below).

Size of the B.C.-based Mineral Exploration Industry		
Organization	**Estimated Membership**	
BC Yukon Chamber of Mines	Individuals Service Companies	2,500 200+
Vancouver Mineral Exploration Group	Individuals Exploration Companies and Consultants	1,300 600

B.C. Government figures estimate the full-time equivalent employment associated with mineral exploration at 700 people. This is down from over 1,400 in 1996. It should be noted, however, that much of the B.C.-based employment associated with mineral exploration is

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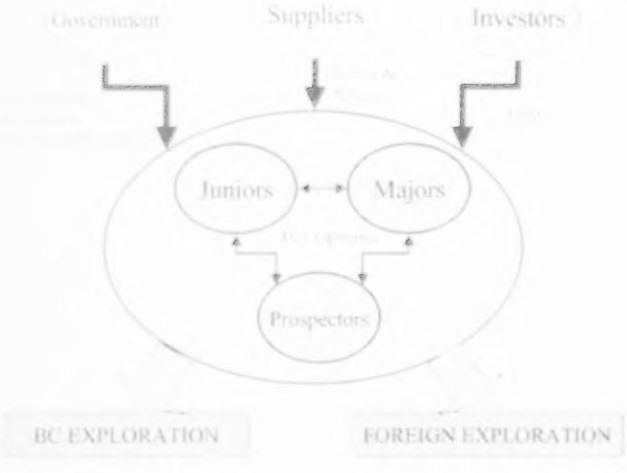

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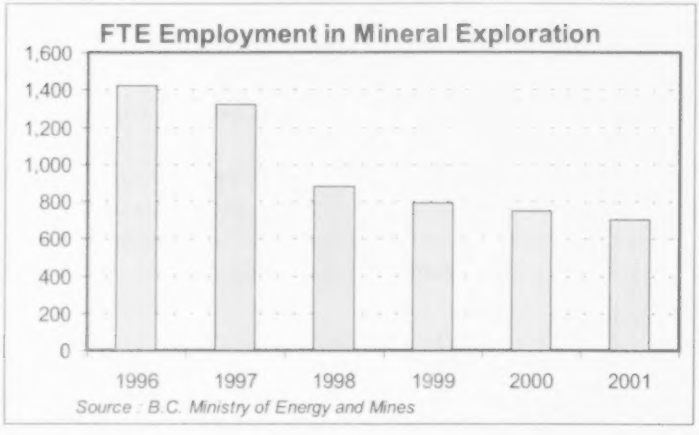
directed at exploration activities outside the Province. The reduction in B.C. exploration expenditures does not necessarily imply a corresponding reduction in B.C. exploration employment.



Government

Governments are owners of the mineral rights, providing regulation and collecting royalties and taxes on producing mines.
Governments (both provincial and federal) also provide a crucial service to industry in collecting and distributing scientific information relating to geology, mineral deposits, and mineral production. This information is extremely valuable to industry and much of it is made available to explorationists through the Ministry of Mines website[7].

Individual Prospectors

Individual prospectors are people for whom prospecting for minerals is either a hobby or a full-time profession. Many prospectors have full-time jobs elsewhere, but have educated themselves in geology and mineral identification for those occasions when they can pursue their extra-curricular activities. The B.C. & Yukon Chamber of Mines provides such training for prospectors.[8]

Several B.C. mineral deposits have been found by prospectors, who typically enter into option arrangements with exploration companies who have the financial resources to pursue further exploration of the find. These option arrangements can include cash payments, share issuances to the prospector, and/or royalties or Net Profits Interests on any eventual production.

Service Providers

Service providers include businesses and individuals that provide needed goods or services in support of exploration activities in BC and elsewhere. A review of the BC Yukon Chamber of Mines membership (in the service company category) reveals approximately 230 service companies listed in over 200 categories ranging from Aerial Lifts to Wire-ropes. Service providers also include accounting firms, banks and brokerage houses that provide financial services to exploration firms.

2.4 Industry Organizations

The B.C. mineral exploration industry is represented by a number of organizations, primarily the B.C. and Yukon Chamber of Mines[9] (BCYCM), the Yukon Chamber of Mines, the Prospectors and Developers Association of Canada (PDAC)[10] the Northern Prospectors Association[11], and the Northwest Mining Association[12] in the United States. The

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BCYCM in particular provides training for would-be prospectors, forums for explorationists and dissemination of exploration information, as well as representing the interests of the exploration industry in B.C. and the Yukon. Explorationists have organized their own regional groups such as the Vancouver Mining Exploration Group (MEG)[13], Kamloops Exploration Group (KEG)[14] and Smithers Exploration Group[15] for presenting technical information to their members.

There are other industry groups such as the Mining Association of BC (MABC)[16], the Mining Association of Canada[17] that represent the interests of mine operators and suppliers. Mine suppliers and consultants also have representation through their own association, the Mine Suppliers, Contractors and Consultants Association of B.C.[18], which is affiliated with the MABC.

The Canadian Institute of Mining and Metallurgy (CIM)[19] is mainly a technical forum for the industry that addresses many technical issues including industry reporting standards (for reserves and valuations for example), training and dissemination of information on technical matters.

Organizations such as the Association of Professional Engineers and Geoscientists of B.C.[20] are authorized by statute to regulate the actions of its membership, including geologists, mining engineers and other engineering professionals.

2.5 Competitive Aspects of Mineral Exploration

Mineral exploration is undertaken in the expectation of future profits. Companies and individuals are constantly looking for new exploration ideas and opportunities to acquire mineral properties of merit. It is a very competitive business.

Hundreds of exploration companies compete to secure the best exploration talent and best properties on a worldwide basis. Many, perhaps even a majority, of exploration companies based in B.C. are exploring for minerals outside the Province. These firms will go where there is opportunity.

2.6 B.C. Mineral Exploration Expenditure Trends

Provincial exploration expenditures have been on the decline for several years. B.C. exploration expenditures have fallen from $177 million in 1997 to a projected $48 million in 2002[21]. Additionally, B.C. percentage share of the Canadian total exploration spending has fallen below 7%, well below the historic range of 10 to 25% in the 1980's up to the late 1990's These trends, which are of major concern to the industry and government, is attributable to a number of factors including low worldwide metals prices, provincial policies perceived as unfavourable to the industry, uncertainty over native land claim settlements and better exploration opportunities elsewhere.

The recent increase in gold prices has generated a flurry of financings which may provide at least a temporary increase in exploration activity. However, the restoration of B.C.

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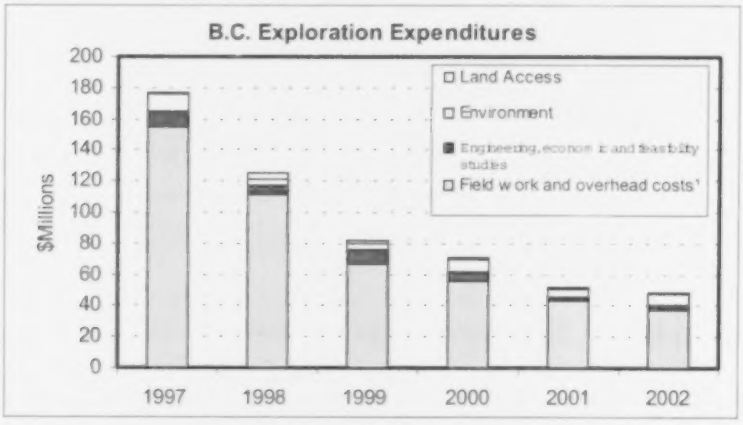
exploration expenditures to more healthy levels will depend on stronger commodity prices, an attractive investment environment in B.C. (including settlement of land claims), and of course identification of new and attractive geological targets.

BC Historical Exploration Expenditures						
	1997 Actual	1998 Actual	1999 Actual *	2000 Actual *	2001 Preliminary *	2002 Forecast
Field work and overhead costs	154,217,896	110,619,738	66,750,799	55,518,375	43,122,003	37,781,580
Engineering, economic and feasibility studies	10,770,075	6,381,273	8,723,036	5,633,345	2,358,885	3,044,500
Environment	11,142,151	3,930,506	4,668,041	8,652,773	4,748,000	7,100,500
Land Access	885,452	4,049,067	1,647,266	1,333,854	926,000	529,000
Total Exploration	**177,015,574**	**124,980,586**	**81,789,143**	**71,138,347**	**51,154,888**	**48,455,580**

The exploration expenditures above include expenditures for pure exploration, for deposit appraisal and exploration associated with existing mine complexes. According to PDAC, junior exploration companies account for approximately 40-50% of exploration funding in Canada with senior mining companies responsible for most of the balance.



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2.7 Sources of Exploration Financing

Mineral exploration funding consists of high risk dollars. These dollars comes from several sources:

1. Individual prospectors spending their personal funds or funds provided by friends and family;
2. Government funds, in the case of exploration surveys and information, partnership programs and direct prospectors assistance programs (if available);
3. Internally–generated cash in the case of operating mining companies (generally larger mining companies). These funds can be spent directly by the companies or indirectly through investments in junior exploration companies or joint ventures with juniors;
4. Individual investors, institutions and funds.

Flow-through Shares

For qualifying exploration expenditures within Canada, Federal and provincial programs provide for shares issued for the purpose of funding these programs, the "flow-through" of Canadian Exploration Expense (CEE) deductions to individual investors buying these flow-through shares. Exploration companies issuing flow-through shares renounce the tax deductions arising from those shares to the investors who can reduce their income taxes otherwise payable. This has the effect of reducing the effective cost of the shares to the investors. Certain provinces also provide for additional tax incentives to investors providing exploration dollars.

The flow-through share program has been very popular and has made a substantial contribution to funding mineral exploration in Canada. Foreign exploration cannot be funding using flow-through shares.

2.8 Mineral Exploration Secondary Economic Effects

Mineral exploration expenditures have large indirect and induced employment effects. Exploration is a labour intensive activity that relies on a myriad of consultants, contractors and other services suppliers. The indirect employment effects are considered to be quite large. Induced employment arises from employment generated by wages paid by mineral industry service suppliers. The mining industry as a whole is generally thought to generate 3 jobs indirectly for every job directly attributable to expenditures. Figures for mineral exploration specifically are harder to come by, but it is probable that the employment multipliers are greater due to the high labour intensity of exploration (compared with mining in general) in and the high proportion of the dollars spent on consultants, contractors and suppliers. A table summarizing activities and opportunities during the stages of exploration is shown below.

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Typical Activities/Employment Opportunities		
Preliminary Exploration	**Advanced Exploration**	**Feasibility**
Geological consulting	Geological consulting	Engineering consultants: reserves, mining, metallurgy, economics
Silt, soil sample collection	Geophysical contracting	Environmental consulting services
Claim staking; line cutting	Local accommodation	Local accommodation
Geophysical contracting	Local supplies, gas, groceries	Local supplies, gas, groceries
Local accommodation	Local casual labour	Camp construction; suppliers
Local supplies, gas, groceries	Camp construction; suppliers	Road construction contractors
Local casual labour	Helicopter support	Trucking/shipping
Helicopter support	Truck rentals	Truck rentals
Truck rentals	Airline/air support services	Airline/air support services
Airline/air support services	Assaying	Surveying
Assaying	Surveying, mapping	Corporate services: offices, office support equipment, legal accounting, investment banking; project financing advisory
Surveying, mapping	Environmental services	
Corporate services: office space, office support equipment, legal, accounting, investment banking	Corporate services: offices, office support equipment, legal accounting, investment banking	

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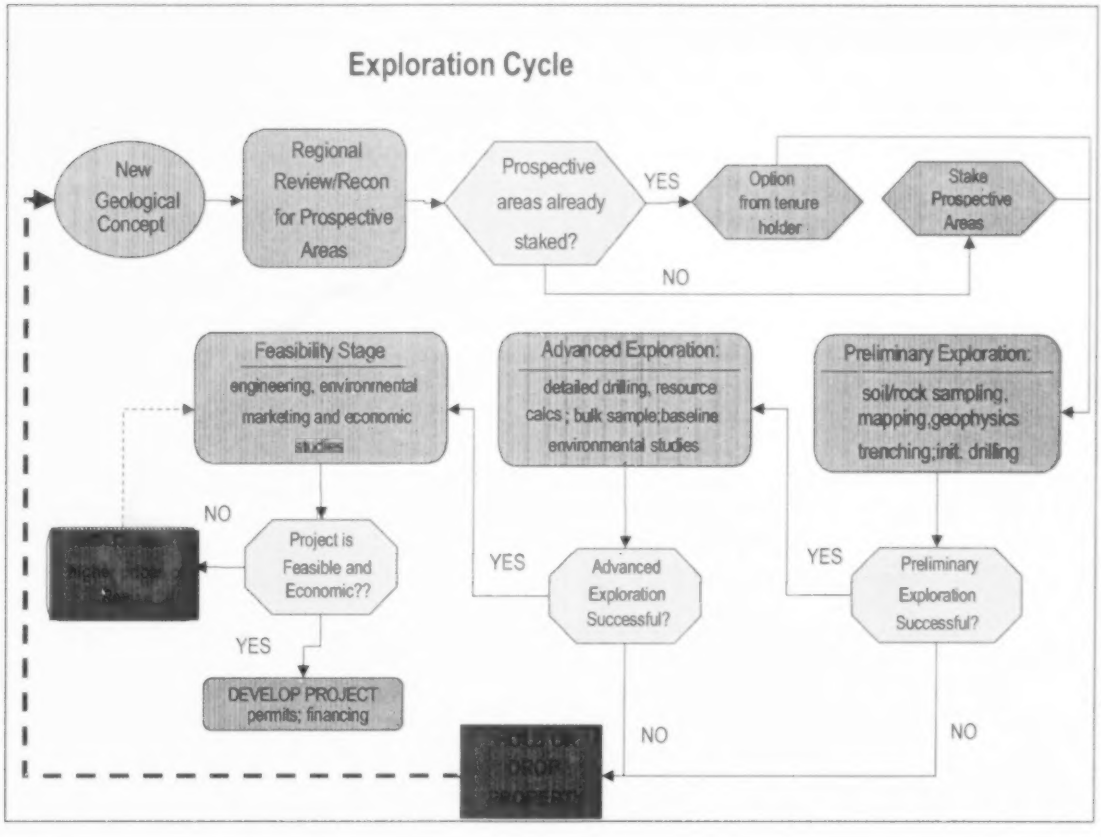
3.0 THE EXPLORATION CYCLE

The typical exploration cycle follows a process from geological concept formation and reconnaissance exploration, advanced exploration, feasibility studies and possible development. At each stage in this process, the collected information is evaluated before a decision is made whether to progress to the next stage, revise the concept or abandon it entirely. This process is illustrated in the figure below.



Each stage of this cycle of exploration has differing types and levels of information requirements, environmental impacts, permitting, expenditure levels and differing sets of required skills.

Additionally, the time periods involved in early stage exploration can be quite long with many companies competing to locate deposits that merit further development. The projects that meet this standard are fewer in number (with correspondingly fewer companies involved) and the costs of exploration rise as drilling and more detailed surveys are undertaken (see figure below). If results continue to be promising, initial engineering and feasibility studies are initiated. At this stage, junior exploration companies often choose to spread the costs and risks of further development by soliciting the involvement of senior mining companies.

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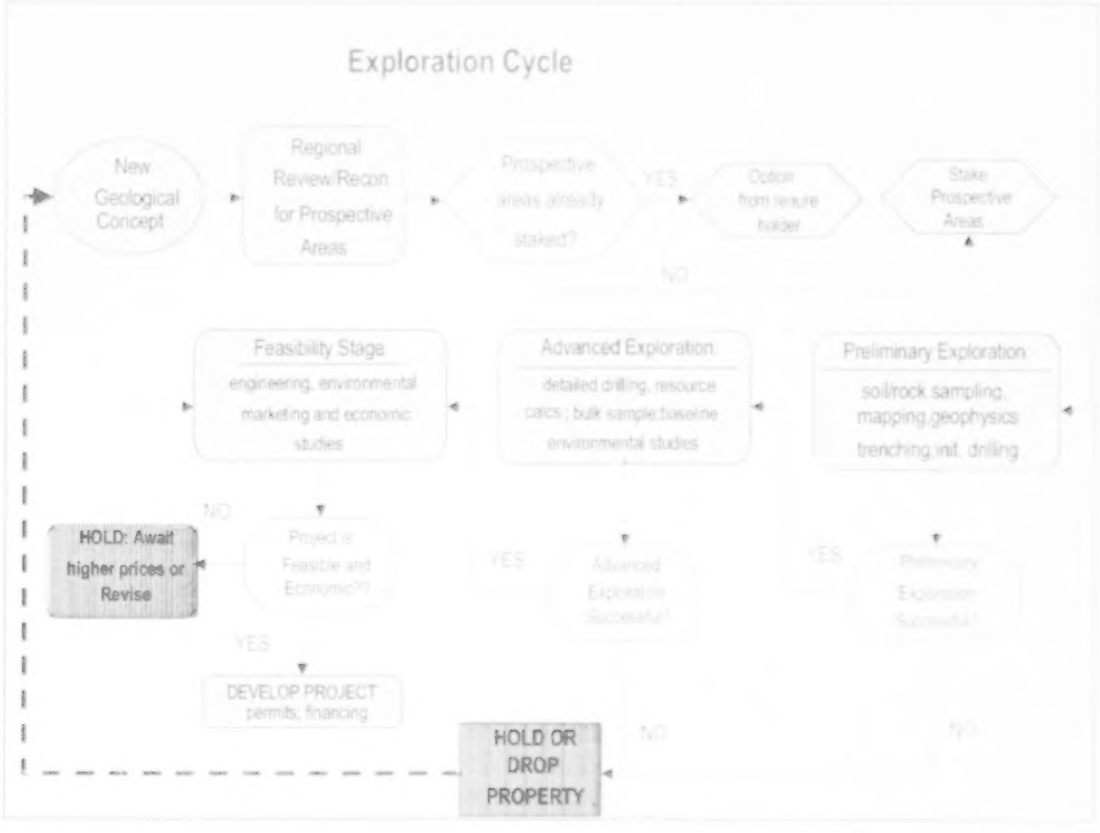

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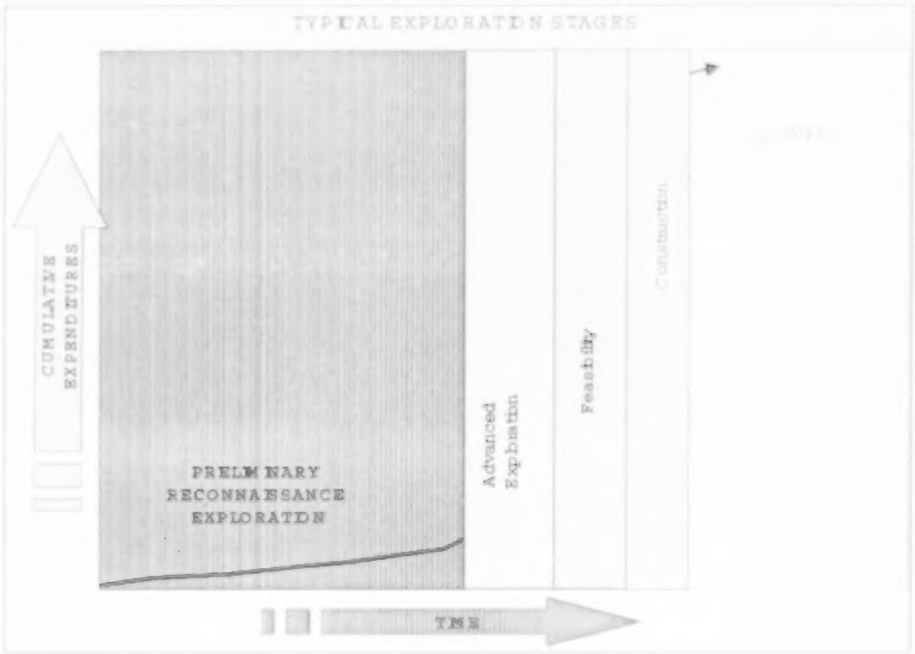
Sources of Information

The B.C. Government Ministry of Energy and Mines Geological Survey Branch maintains an extensive information database on the geology and mineral occurrences within the province as well as work reports submitted to the government by claim holders. Topographic maps, digital terrain models[1], aerial photos and orthophotos and regional geophysical surveys can be obtained from Natural Resources Canada[2] and/or their designed private sector suppliers of this information. Satellite imagery is obtainable from government or private sector sources. In some areas, private sector contractors undertake speculative geophysical surveys for their own account, which are available to third parties for a fee.



Acquiring Tenure

Acquiring mineral tenure can be done directly by location of mineral claims if the area has not been staked (see earlier sections), or indirectly, by entering into option or joint venture arrangements with the current owners of the mineral tenures. The incoming party typically agrees to undertake certain cash payments, work commitments and/or future royalties (or some combination of these) to earn an interest in the mineral tenures.

Permits and Regulations

In B.C., exploration activities are governed by the *Mines Act*. An Exploration Activities and Reclamation Permit is required to conduct exploration in B.C. This permit will reference a Notice of Work and Reclamation document that describes the proposed exploration activities and incorporates a number of schedules specific to certain exploration activities. The notice must be submitted to the district mines inspector and other ministries that may be affected by the work program. The permit applications are also be made available to the First Nations who may potentially be affected and, at the discretion of the mines inspector, other interested parties for technical comment.

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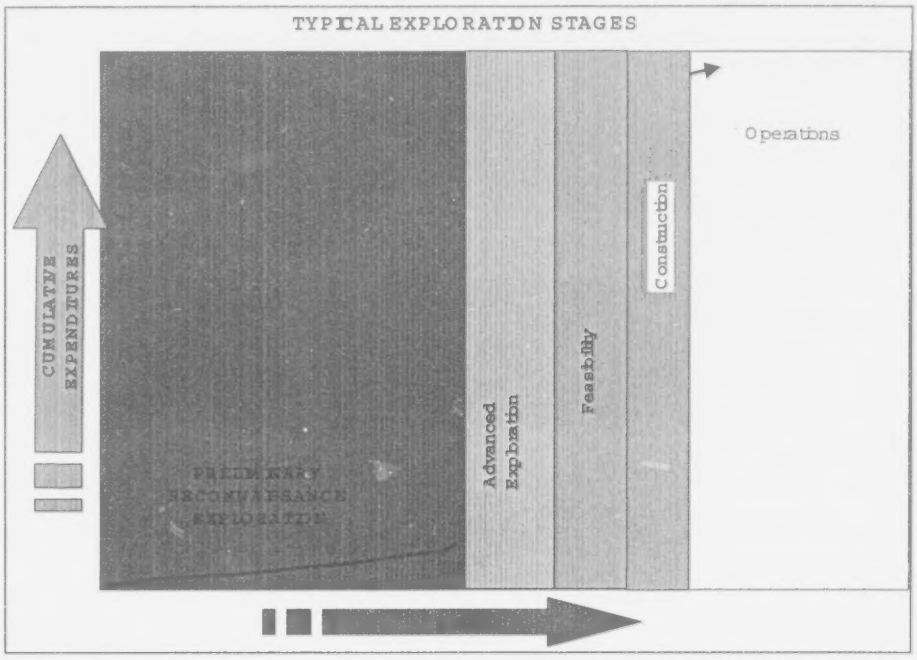

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For advanced project developments, additional Provincial and Federal statutes may be triggered. These include: *Forest Act*, *Range Act*, *Forest Practices Code Act*, *Soil Conservation Act*, *Agricultural Land Reserve Act*, *Land Act*, *Highway Act*, *Water Act*, *Heritage Conservation Act*, *Environmental Assessment Act*, *Fish Protection Act*, *Waste Management Act*, *Wildlife Act*, and *Navigable Waters Protection Act*.

3.1 Research, Reconnaissance and Preliminary Exploration

Geological Concept Formation

Successful and efficient exploration for mineral deposits requires a concept as to the type of minerals you wish to find, the types of deposits in which such minerals are to be found and the areas where such deposits are most likely to be located. In order to establish this concept, geological knowledge gained through education and/or experience is essential along with geological information on the areas where exploration is to occur.

Typical Activities

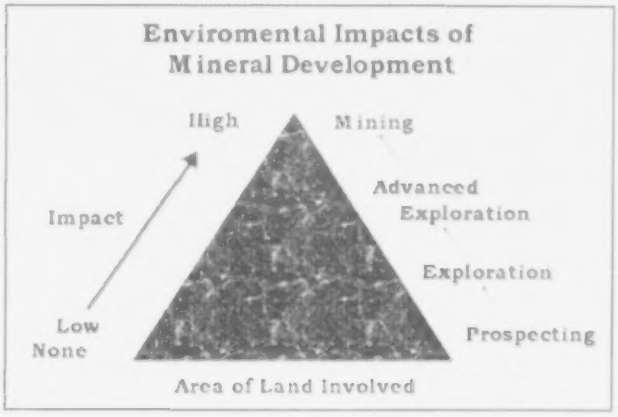
Activities during this stage of exploration can include data gathering, geological research, regional geological and geophysical surveys, field reconnaissance, staking and report preparation.

Relative Costs

The cost of early stage exploration programs can range from $50,000 to $500,000, depending on the extent of field exploration programs incorporated.

Environmental Impacts/Best Practices

Information on environmental best practices for explorers is available from several sources. The B.C. Ministry of Mines and Energy maintains an information website containing a Mineral Exploration Code which describes the permitting and regulation of exploration activities[24] on best practice standards in several areas including permitting, health and safety, archaeological sites, roads and access, reclamation, water management, etc. The BC Yukon Chamber of Mines website[25] also provides links to websites containing best practice information for explorers.



The PDAC also has developed "**Environmental Excellence in Exploration**" (E3) electronic manual that is available to explorers. E3 is a tool that provides explorationists with up to date information and guidance on best practices in environmental and socio-economic stewardship in exploration.

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Service Providers, Employment and Skill-sets

Much of the work in mineral exploration is provided by consultants, exploration contractors and the associated suppliers of goods and services necessary to support field activities. These can include geological and geophysical contractors and consultants, field assistants, camp caterers, assay labs, suppliers of helicopter and fixed wing aircraft, truck and car rentals etc. Some local employment is possible particularly with local suppliers or goods and services. Skilled labour will include geologists, geophysicists, geochemists and specialists with training or skills in exploration–related support activities such as pilots.

First Nations and Public Consultation

Exploration permits are required to provide complete disclosure of any proposed exploration work program. First Nations are normally provided with details of exploration activities that may affect them as described in the Notice of Exploration and Reclamation. Early stage exploration normally is low impact, with camps and structures mostly temporary in nature. In certain cases it may be advisable to provide initial information to the public at large when the proposed activities are highly visible, even if the impacts are expected to be temporary and minimal. This would also be a good forum to discuss any present and future employment opportunities with local resident and First Nations groups.

3.2 Advanced Exploration

At this stage of exploration, sufficient encouragement has been obtained from initial exploration to warrant further expenditures. This encouragement may have been in the form of geophysical or geochemical anomalies, favourable geology, assays of rock samples, or combinations of those.

Typical Activities

Advanced stage exploration programs generally involve gathering more detailed subsurface information utilizing trenching and drilling. Depending on the nature of the results, work such as further detailed geological mapping, ground geophysical surveys, topographic surveys, soil sampling and drilling may be scheduled. Improved access to the property may be required, necessitating new road construction or upgrading of existing roads and/or development of an airstrip. To support these activities, a certain amount of infrastructure must be established. Temporary camps for geologists and drillers are set up, often using structures specifically designed for such purposes (see photo on the right). Access roads, drill roads and helicopter pads are constructed as necessary. Initial resource estimates are developed based on these preliminary drill programs. Environmental baseline studies and preliminary metallurgical studies are often initiated at this stage.

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Relative Costs

The detailed studies undertaken in advanced exploration programs greatly increase the costs, which can range from $500,000 to $5 million.

Service Providers, Employment and Skill-sets

With exploration advancing, contractors involved in drilling, and consultants specialized resource estimation and environmental work are needed. Heavy equipment contractors are needed for any road or airstrip construction as are suppliers of camp facilities. Local employment opportunities will depend on the location of the project relative to towns and infrastructure.

First Nations and Public Consultation

At the advanced exploration stage, exploration activities intensify, become more visible to the community and have more potential impacts. Consultations with First Nations and the public should be more frequent through informal meetings and public forums as necessary.

3.3 Feasibility Stage

At this stage of property development, exploration results have been sufficiently encouraging to justify starting engineering and economic studies. These studies investigate ways to develop the property as a technically and economically feasible, environmentally-sound, mining operation.

Typical Activities

Feasibility-stage studies typically include investigation of possible mining and processing methods, estimates of mineable resources, continuation of environmental studies, and marketing and economic studies. Detailed in-fill drilling is also required to provide additional confidence on the resource estimates. Feasibility studies are detailed engineering investigations of the technical, economic and environmental effects of a proposed mining operation. The major sections of a typical feasibility study are highlighted in the table below. Feasibility studies are major documents and can comprise up several volumes including those of ancillary studies.

In many cases, a scoping study and/or "Preliminary Feasibility Study" is undertaken prior to a full feasibility study. These are less detailed and less costly studies that provide initial guidance on the preferred mine development options and the relative economics of those options.

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Feasibility Stage Costs

Properties in the feasibility stage of development can involve expenditures of range from $2 to $10 million or more, including provision for the detailed drilling and the many associated engineering studies.

Typical Feasibility Study Sections
Executive Summary
Project Description
Geology and Reserves
Mining
Process
Tailings and Waste Rock Impoundment
Metal Marketing
Infrastructure & Power Generation
Environment & Permitting
Project Schedule
Capital Cost Estimate
Operating Cost Estimate
Economic Analysis

Service Providers, Employment and Skill-sets

With the project advanced to the engineering feasibility stage, contractors involved in drilling, and consultants specialized resource estimation, engineering and environmental work are needed. Heavy equipment contractors are needed for any road or airstrip construction as are suppliers of camp facilities. Local employment opportunities will depend on the location of the project relative to towns and infrastructure.

3.4 Financing and Project Development

The final two steps in mineral project development are acquiring the necessary project capital funding and initiating construction. In addition, before construction starts, detailed engineering and planning work is often required, beyond that which is normally included in a feasibility study.

Project capital funding is typically composed of equity and debt components. The debt portion is provided by lenders who have conducted sufficient technical due diligence to be satisfied as to the technical and commercial viability of the project. Lenders also must be satisfied that all title, permitting and environmental issues have been adequately addressed as to not present undue risks. Lenders are primarily focussed on mitigating (as much as possible), any risk that their funds cannot be repaid. The amount of debt provided by lenders is based on parameters specific to each project, such as projected cashflows, and the level of corporate loan support provided. Generally, lenders have certain "cover ratios" and other loan covenants which the project and its sponsors must meet. Lenders will normally require a certain level of metal price "hedging" to reduce the price risk associated with the project and of course will require secure marketing contracts covering the sale of the mineral products in the case of non-fungible minerals, metals or concentrates.

Once the loan parameters and loan amount is established, the amount of equity required can be determined. The total project capital usually contains a provision for cost overruns, either as a standby loan facility or additional funds placed in an escrow account. Once the project has been constructed and placed into operation, certain "completion tests" must be met in order for project loans to become "non-recourse" to the corporate project sponsors. These tests ensure the project has been constructed and is operating within certain design parameters. With the technical project risks largely eliminated, the lender then has recourse only to the project itself for loan security.

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Lenders and providers of project equity are very sensitive to any issues surrounding project title, native land claims, environment, and permitting. Any perceived impediments to a timely project development will delay, or sink, any proposed project financings.

REFERENCES

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[1] See http://www.em.gov.bc.ca/Mining/Geolsurv/MapPlace/Default.htm

[2] This sort of exploration information can be viewed at http://ebony.gov.bc.ca/mapplace/minpot/ex_assist.cfm. Use of this site may require the download of free viewing software. Links for doing this are available at the site.

[3] http://www.nrcan-rncan.gc.ca/inter/index_e.html

[4] Details of the Mineral Tenure Act can be found at: http://www.qp.gov.bc.ca/statreg/stat/M/96292_01.htm

[5] Details of the Mines Act can be found at the following website: http://www.qp.gov.bc.ca/statreg/stat/M/96293_01.htm

[6] http://www.em.gov.bc.ca/Mining/Healsafe/mxready/guide and

[7] http://www.em.gov.bc.ca/Mining/Geolsurv/default.htm

[8] http://www.bc-mining-house.com/educ/educationoverview.htm

[9] http://www.bc-mining-house.com/welcome.htm

[10] http://www.pdac.ca/

[11] http://www.northernprospectors.on.ca/

[12] http://www.nwma.org/

[13] http://www.bc-mining-house.com/toolkit/meg/Megtks01.htm

[14] http://www.keg.bc.ca/

[15] http://www.bc-mining-house.com/assoc/smithers/welcome.htm

[16] http://www.mining.bc.ca/

[17] http://www.mining.ca/english/information/

[18] http://www.mscca.com/member_benefits.asp

[19] http://www.cim.org/index2.html

[20] http://www.apeg.bc.ca/flash.html

[21] Source: B.C. Ministry of Energy and Mines

[22] http://www.nrcan-rncan.gc.ca/inter/maps_e.html

[23] http://airphotos.nrcan.gc.ca/main.html

[24] http://www.em.gov.bc.ca/Mining/Healsafe/mineereg.htm

[25] http://www.bc-mining-house.com/toolkit/bestprac.htm

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